

Lawver (W. P.) al

TABLES
FOR THE
PRACTICAL EXAMINATION
OF
URINE, URINARY DEPOSITS & CALCULI,

PREPARED FOR THE USE OF THE
STUDENTS OF THE NATIONAL MEDICAL COLLEGE,
COLUMBIAN UNIVERSITY,

Presented by

BY

W. P. LAWVER, M. D.

*Columbian Univ.
Washington D.C.*



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Scheme for the Clinical Examination of Urinary Deposits.

Name.	Color.	Heat.	HCl.	HNO ₃ .	Other Confirmatory Tests.	Microscopical Examination.	
Amorphous or neutral alkali urate	Brown, Orange, Pink or Purple, to Brick Red	Soluble.	Soluble.	Soluble.	Reprecipitates when cooled; found in acid urines.	Shows minute particles or granules, coarser or finer, more or less opaque according to closeness of aggregation.	
Ammonium urate.	White to violet.	Soluble.	Soluble.	Soluble.	Reprecipitates when cooled in the form of thorn apple spherules; found in ammoniacal or alkaline urine; responds to murexide test.	Shows globular and thorn apple spherules, which appear almost black by transmitted light.	
Phosphates.	White.	Insoluble	Soluble.	Soluble.	Precipitates gelatinous deposit on adding ammonia.	Shows crystals of the triple phosphates, triangular prisms with beveled edges, &c., soluble in acetic acid, while the octahedra of lime are unaffected.	
Uric acid.	Red.	Insoluble	Insoluble	Soluble.	Murexide test: Rub up the concretion; put in porcelain dish and add a few drops HNO ₃ and H ₂ O; warm carefully until dissolved; evaporate carefully until almost dry; add a drop of NH ₄ HO. The interior of the dish will become a purple red color.	Shows rhombic, dumb bell, six-sided plates, rectangular tables, saw and fan shaped crystals.	
Oxalate of lime.	White.	Insoluble	Soluble.	Soluble.	Reprecipitates in a granular form on adding ammonia.	Shows characteristic quadrilateral octahedra crystals; rarely dumb bell shaped	
Cystine.	White.	Insoluble	Insoluble	Insoluble	Soluble in NH ₄ HO.	Shows hexagonal crystals.	
Blood.	Red or smoky brown.	Insoluble	Insoluble	Insoluble	Generally albumen in fluid. Hæmine test: Precipitate phosphates with KHO, warm. If blood is present the phosphates will appear blood-red instead of white. To an equal vol. of tinct. guaiacum and oil of turpentine mixed add the urine drop by drop; if blood is present an indigo blue will appear.	Shows blood corpuscles; they are not colored by carmine, and swell in acetic acid.	
Pus.	Yellow.	Insoluble	Insoluble	Insoluble	Deposit mixes on shaking, or becomes diffused.	Shows pus corpuscles having several nuclei, round, pale granular bodies; acetic acid causes them to swell.	
Mucus.	Cloudy.	Insoluble	Insoluble	Insoluble	Deposit does not mix on shaking. It differs from pus in not being precipitated by Pb (C ₂ H ₃ O ₂) which precipitates the Pryn of pus.	Shows a granule nearly spherical; cells somewhat larger than a blood corpuscle; a single nucleus as a rule; also a thin transparent substance similar to their interlacing fibrils.	

URINARY CASTS.

Epithelial.		A cylinder of coagulated matter studded over with epithelial cells.
Hyaline, transparent or waxy.	Swell in chemically pure H_2O ; dissolve in it at $60^{\circ} F$. Soluble in 10 per cent. sol. carb. soda or amm., shrink in alcohol and tannic acid; heated with Million's reagent are colored violet.	Clear glassy fibrinous cylinders, which glisten like wax and which are frequently so transparent as to be invisible until tinted with iodine or magenta solution.
Brownish-yellow, nucleated or granular.	Do not swell in H_2O , or $NaCl$, or Na_2CO_3 , nor shrink in alcohol or tannic acid, but dissolve in 1 per cent. solution HCl and glacial acetic acid and alkaline solutions.	Having a dark, coarsely granular appearance, generally wider in diameter than the Hyaline cast.
Fatty.		Oily particles studded over a transparent cast or collected in dark granular masses.
Blood.		Generally a fibrinous cast studded irregularly with blood corpuscles, some perfect and some withered and contorted or crushed.
Pus.		Moulds or casts of the uriniferous tubes composed of pus corpuscles.
Reddish-brown cylinders made up of urates or collections of bacteria are sometimes found in the urine.		
Epithelium.	From ureter, urethra, pelvis of kidney, bladder and vagina. Sometimes extraneous matter, as hair, cotton and woolen fibres, oil globules, &c., are found.	

Scheme for the Clinical Examination of Liquid Urine.

First—	Second—	Third—	Fourth—	Fifth—	Sixth—
Note the quantity passed in 24 hours.	The color: Whether normal or abnormal.	The odor: Whether normal or abnormal.	The reaction: Whether faintly, moderately, excessively, or neutral.	Specific gravity: If from 1025 to 1055 examine for sugar and excess of urea; if below 1015 for albumen; if between 1001 and 1010 expect diabetes insipidus.	Quantity and character of the urinary deposit.
Name.	Color.	Reaction.	Sp. Gr.	Heat.	HNO_3 .
Albumen	Varies	Varies	Varies	White Precip.	White Precip.
Sugar	Varies	Usually acid	High	.....	.....

Other Confirmatory Tests.

1.—Heat. 2.—Nitric acid, by Heller's overlaying method. 3.—Heat and acetic acid. If much carb. of ammonia present add $\frac{1}{2}$ part of liquor potassæ to the urine, warm and filter; if then not clear add a few drops of magnesian fluid, warm again and filter, and add HNO_3 . 4.—A standard solution of potassium mercuric iodide, after free acidulation of urine by citric acid, viz: Iodide potassium, 3.22 grams; bichloride of mercury, 1.85 grams; distilled water to make 100 c. c. Five c. c. will precipitate .005 grams of albumen. 5.—Equal parts of a saturated solution of sodium tungstate (1 in 4) and a saturated solution of citric acid (10 in 6) and of water. 6.—A saturated solution of picric acid, to which is added 2 drachms of citric acid to each ounce of the solution. 7.—A saturated solution of ferrocyanide of potassium, after free acidulation of urine by citric acid. 8.—To a pint of a saturated solution of salt water add an ounce of HCl. 9.—A solution of equal parts carbolic and acetic acid. Heat must be combined carefully with all these tests.

1.—Fehling's: Take 34.639 grams c. p. cryst. $CuSO_4$, dissolve in 200 c. H_2O ; then 173 grams cryst. tartarate soda dissolved in 500 or 600 grams solution caustic soda, 1.12 sp. gr. (17 Baume). Into this pour the $CuSO_4$ solution, stir and dilute to 1 liter; 10 c. c. will reduce 50 mg. of diabetic sugar. 2.—Add an equal bulk of a saturated solution of picric acid to the urine, then a few drops of liquor potassæ, and gently apply heat. The solution will gradually acquire a deep red-brown color. 3.—Mulder's color test: Heat the urine, previously made alkaline by carbonate of soda, with a solution of indigo carmine, the blue mixture becomes green, then purple, red and finally straw yellow, and upon shaking again passes to blue. 4.—Bottinger's test: Treat 2 vols. of urine with 1 of KHO, then add a small quantity of magistral (a mixture of basis bismuth subnitrate and bismuth nitrate), and heat to boiling. The black suboxide of bismuth will be reduced if sugar is present. 5.—Trommer's test: Treat 2 vols. of urine with 1 vol. of KHO, then add a solution of $CuSO_4$ (1 to 10) until it assumes an azure blue; boil, yellow cuprous hydroxide appears, and then cuprous red, if sugar is present. 6.—Heller's or Moore's test: Treat 2 vols. of urine with 1 vol. of KHO and heat to boiling, a lemon yellow, yellowish brown or blackish brown color appears; treat with HNO_3 and it will give the odor of molasses if sugar is present. 7.—Fermentation test: Fill a long test tube, having a perforated cork through which a fine bent glass tube passes nearly to the bottom, with urine to which some yeast has been added, insert the tube over a saucer containing the urine under examination, and set aside in a warm place; sugar, if present, will be decomposed into carbonic acid and alcohol, and the gas will collect in the upper part of the tube.

Urea	Excess	Varies	Varies	High, or over 1025	.....	Crystals Nitrate of Urea.	With oxalic acid forms crystals of oxalate of urea. For excess, add an equal volume of strong HNO_3 to the urine in a test tube, and plunge the tube into cold water; if there is an excess of urea the mixture will speedily become a shining mass of crystals of nitrate urea. The one most suitable for the physician's use is the hypobromite process after Apjohn: Dissolve 100 grams of solid c. p. caustic soda in 250 c. c. of H_2O , and add 25 c. c. of bromine; 15 c. c. of this is placed in a bottle having a rubber cork with a glass tube passing through; 5 c. c. of urine is poured into a short test tube and placed in the same bottle; a piece of rubber tubing connects this with the burette or measuring glass; mix the urine and hypobromite, and relieve the disengaged nitrogen from the hydrostatic pressure. Each division of developed nitrogen shown on the measuring glass corresponds to .44 grains of urea per fluid ounce. If 45 ounces of urine were voided in the 24 hours, and 5 c. c. of this evolves 30 measures of nitrogen gas, then $.44 \times 30 = 13.20$ grs. per ounce or $13.20 \times 45 = 594$ grs. were eliminated during the 24 hours.
	Deficiency.	Varies	Varies	Low	.....	.....
Uric acid	Red	Acid	Varies	Varies	.....	.....	Strongly agitate 200 c. c. of urine with 10 c. c. of fuming HCl for 5 minutes; set aside for an hour; filter through a weighed double filter; dry at 100° , and weigh.
Bile	Varies	Varies	White Precip. generally	Varies	Colored greenish yellow to d'k brown		1.—Gmelin's test: Take strong HNO_3 with a little ($\text{HNO}_3 + \text{NO}_2$) in the zone between the fluids, there occurs from below upward the colors green, blue, violet, red and yellow; this test may be made by adding weaker HNO_3 to the urine in a test tube, and pouring under this mixture a layer of concentrated H_2SO_4 . 2.—Heller's test: Pour into a test tube 6 c. c. of pure HCl , and drop the urine into it until the acid is distinctly colored; stir; beneath pour a layer of pure HNO_3 ; in the intermediate zone a beautiful iridescence will appear; upon stirring the entire mixture will show the colors change successively in the order they had been previously observed between the fluids. 3.—Ultzman's test: To 10 c. c. of urine add 3 or 4 of KHO , (1 to 3 of H_2O), and add an excess of pure HCl , and the mixture will assume a beautiful emerald green color.
Blood	Brown	Varies	Dark Precip.	Varies	Dark Precip.		1.—Haemine test: Precipitate earthy phosphates in a test tube by adding KHO and warming slightly; the phosphates are precipitated and appear blood-red, if blood coloring substances are present; if urine is alkaline add a few drops of magnesium solution previous to heating. 2.—Microscope shows blood corpuscles. Guaiacum test: Add a little freshly prepared tincture of guaiacum to an equal volume of spirits turpentine in a test tube; shake to form an emulsion, pour the urine down the inside of the inclined test tube to form a layer; if blood is present the resinous precipitate becomes blue.
Phosphates	Varies	Varies	White Precip.	Varies	Precip. dissolves		Precipitate with heat dissolves instantly upon the addition of HNO_3 . To a test tube $\frac{2}{3}$ full of filtered urine add a few drops of KHO or NH_4HO , warm. Add to 15 or 20 c. c. urine in a test tube, 5 to 15 drops, of a solution (1:12) of carbonate of soda; a strong opalescence indicates from .06 to .08 per cent. (normal.)
Chlorides	.....	.....	.....	.....	.....		Acidify the urine with HNO_3 , then add 1 or 2 drops of a solution of (AgNO_3) 1:8; if curdy precip. falls the chlorides are not diminished; if only turbidity then there is a deficiency; if no milky cloud they are entirely wanting.
Chyle	White	Varies	White	Varies	White		Separation of fat by ether: Microscope shows granular nucleated corpuscles like those of mucus.
Ammonium Carbonate	Varies	Alkaline	.....	Varies	Effervesces		Odor: Pour into a flask, having a capacity of 100 c. c., 15 to 20 c. c. of urine; close the flask with a cork through which a glass tube is passed the thickness of a lead pencil; into this introduce a strip of moistened litmus paper and gently warm on water bath; if ammonia is present it will go off with the steam, and the red litmus paper will be colored blue.

Whitthaus' Scheme for Determining the Composition of Calculi.

(From Witthaus' Manual of Chemistry, (1883,) p. 343.)

1. Heat a portion on platinum foil:
 - a. It is entirely volatile..... *2
 - b. A residue remains..... 5
2. Moisten a portion with HNO_3 ; evaporate to dryness at low heat; add NH_4HO :
 - a. A red color is produced..... 3
 - b. No red color is produced..... 4
3. Treat a portion with KHO , without heating:
 - a. An ammoniacal odor is observed..... *Ammonium urate.*
 - b. No ammoniacal odor is observed..... *Uric acid.*
4. The HNO_3 solution becomes yellow when evaporated; the yellow residue becomes reddish-yellow on addition of KHO , and, on heating with KHO , violet red... *Xanthin.*
 - b. The HNO_3 solution becomes dark brown on evaporation..... *Cystin.*
5. Moisten a portion with HNO_3 ; evaporate to dryness at low heat; add NH_4HO :
 - a. A red color is produced..... 6
 - b. No red color is produced..... 9
6. Heat before the blow pipe on platinum foil:
 - a. Fuses..... 7
 - b. Does not fuse..... 8
7. Bring into blue flame on platinum wire:
 - a. Colors flame yellow..... *Sodium urate.*
 - b. Colors flame violet..... *Potassium urate.*
8. The residue from 6:
 - a. Dissolves in dil. HCl with effervescence; the solution forms a white ppt. with ammonium oxalate..... *Calcium urate.*
 - b. Dissolves with slight effervescence in dil. H_2SO_4 ; the solution, neutralized with NH_4HO , gives a white ppt. with Na_2HPO_4 *Magnesium urate.*
9. Heat before the blow-pipe on platinum foil:
 - a. It fuses..... *Ammonio-magnesian phosphate.*
 - b. It does not fuse..... 10
10. The residue from 9, when moistened with H_2O , is:
 - a. Alkaline..... 11
 - b. Not alkaline..... *Tricalcic phosphate.*
11. The original substance dissolves in HCl :
 - a. With effervescence..... *Calcium carbonate.*
 - b. Without effervescence..... *Calcium oxalate.*

NOTE.—A fresh portion of the powdered calculus is to be taken for each operation except when otherwise stated.

* These numbers indicate the sections under which next to proceed.

TABLE for Reducing the Indications of a Glass Urinometer to the Standard Temperature (60° F.) when the Specific Gravity has been Taken at a Higher Temperature.

<i>Tempera- ture.</i>	<i>No. to be add- ed to the in- dicator.</i>	<i>Tempera- ture.</i>	<i>No. to be add- ed to the in- dicator.</i>	<i>Tempera- ture.</i>	<i>No. to be add- ed to the in- dicator.</i>
60°	0.00	69°	0.80	78°	1.70
61	0.08	70	0.90	79	1.80
62	0.16	71	1.00	80	1.90
63	0.24	72	1.10	81	2.00
64	0.32	73	1.20	82	2.10
65	0.40	74	1.30	83	2.20
66	0.50	75	1.40	84	2.30
67	0.60	76	1.50	85	2.40
68	0.70	77	1.60	86	2.50

Normal Chemical Constituents of Urine.

<i>Constituents.</i>	<i>Grams.</i>	<i>Per Cent.</i>
Total solids	60. — 70.	4.3 — 4.6
Urea	30. — 40.	2.5 — 3.2
Uric acid.....	0.4 — 0.8	0.03 — 0.05
Creatinine.....	0.5 — 1.0	0.036 — 0.062
Hippuric acid.....	0.3 — 1.0	0.02 — 0.06
Chlorides.....	10. — 13.	0.7 — 0.8
Earthy phosphates.....	0.9 — 1.3	0.07 — 0.08
Sulphates.....	1.5 — 2.5	0.16 — 0.17
Phosphates	2.5 — 3.5	0.19 — 0.22

TABLE for Reducing the Indication of a Glass Thermometer to the Standard Temperature 32° F. when the Specific Gravity has been Taken at a Higher Temperature

Temperature at which taken	Specific Gravity at that temperature	Specific Gravity at 32° F.	Temperature at which taken	Specific Gravity at that temperature	Specific Gravity at 32° F.
60°	0.80	0.80	77°	0.70	0.70
51°	0.71	0.71	70°	0.61	0.61
42°	0.62	0.62	63°	0.52	0.52
33°	0.53	0.53	56°	0.43	0.43
24°	0.44	0.44	49°	0.34	0.34
15°	0.35	0.35	42°	0.25	0.25
6°	0.26	0.26	35°	0.16	0.16
			28°	0.07	0.07

Normal Chemical Constants of Urine

Normal	Abnormal	Normal	Abnormal
Specific Gravity	1.020 - 1.030	Specific Gravity	1.000 - 1.010
Acid Reaction	5.0 - 7.0	Acid Reaction	7.0 - 8.0
Alkaline Reaction	8.0 - 9.0	Alkaline Reaction	9.0 - 10.0
Viscosity	1.0 - 1.5	Viscosity	1.5 - 2.0
Crystallization	1.0 - 1.5	Crystallization	1.5 - 2.0
Crystals	1.0 - 1.5	Crystals	1.5 - 2.0
Epithelial Cells	1.0 - 1.5	Epithelial Cells	1.5 - 2.0
Leucocytes	1.0 - 1.5	Leucocytes	1.5 - 2.0
Bacteria	1.0 - 1.5	Bacteria	1.5 - 2.0
Proteins	1.0 - 1.5	Proteins	1.5 - 2.0